Asthma Benefits in TN due to Historic Ozone Reductions

Michelle Oakes, Ph.D

Presentation Outline

- Ozone (O_3) and Health Effects

- O_3 Health Benefits Study (2000-2013)
  - Project Scope
  - Health Benefits Model
  - Study Results
    - O_3 Concentrations
    - Emissions Reductions
    - Health Benefits: Are regulations/implementation effective in protecting public health?

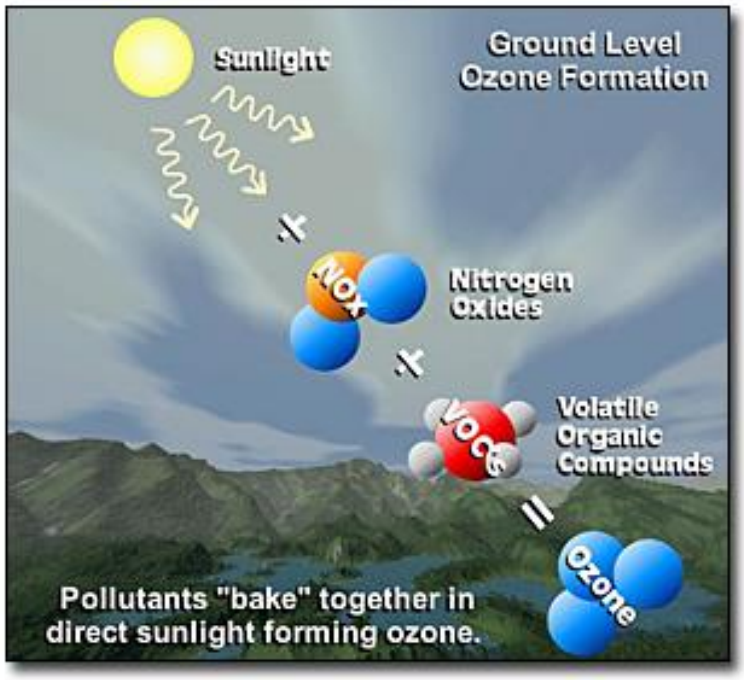
- What's Next?

Ozone (O_3) Formation and Pollution

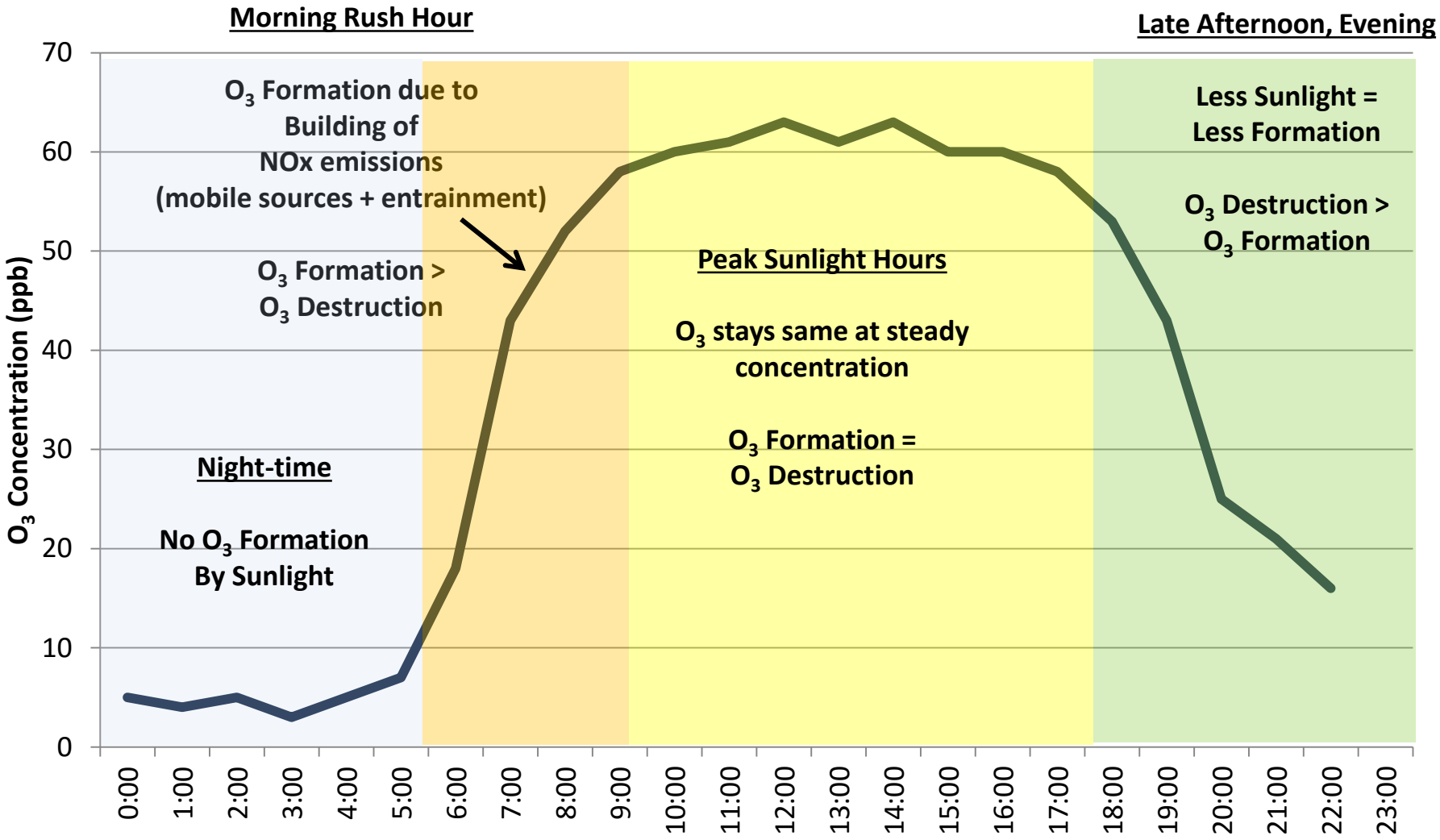
- Not directly emitted, formed by a chemical reaction between (NOx + VOC) and sunlight
  - Different than stratospheric O_3 (ozone layer)

- Concentrations peak during summer afternoons once precursor pollutants have time to “bake” in the sunlight.

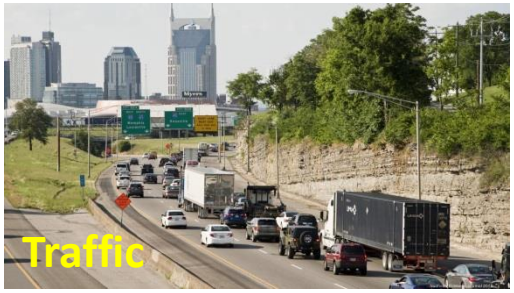
- O_3 formation is primarily limited by NOx emissions in the Southeastern US due to high VOC “biogenic” emissions.

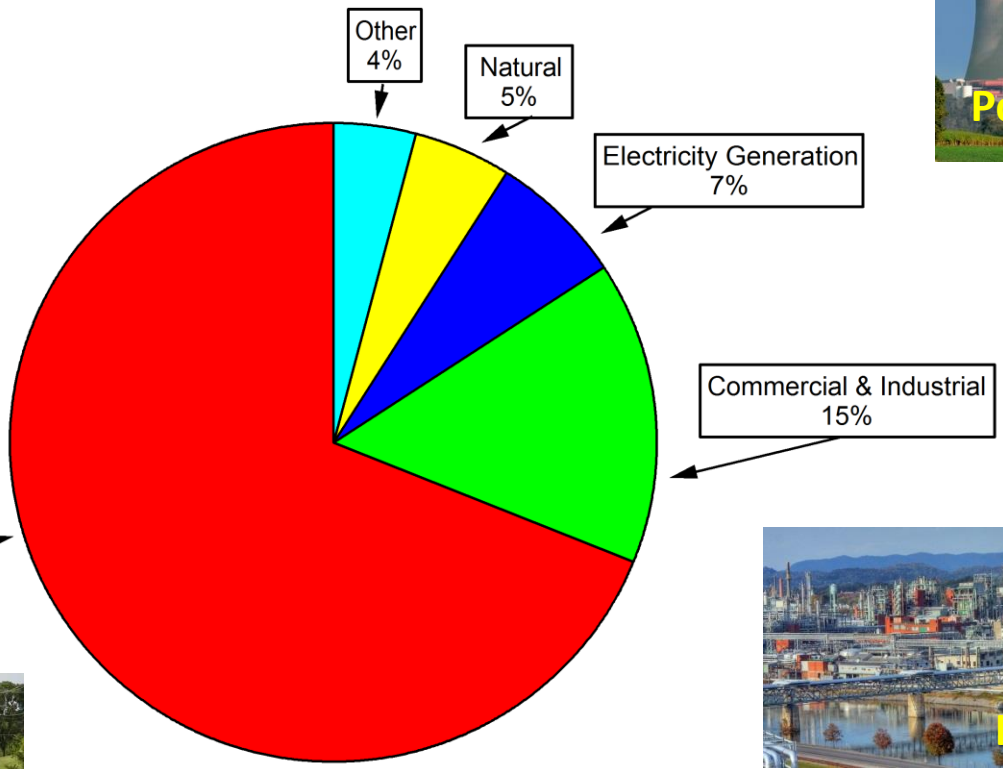


O_3 Hourly Patterns (Hendersonville Site, 6/8/12)



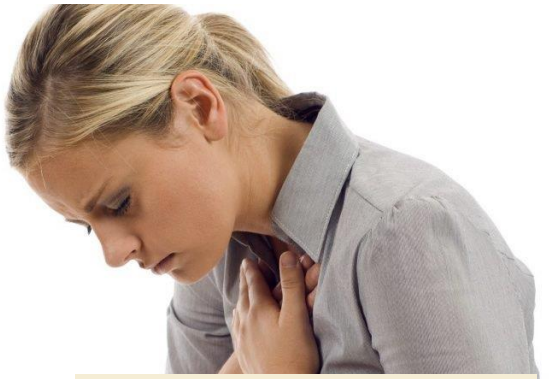
Sources of O_3-Forming Pollution (NOx) in TN





Source: 2014 NEI v2

O_3 Pollution and Health Effects



Respiratory Effects

- ***Asthma***
- COPD
- Lung Function

Cardiovascular Effects

- Heart Attack
- Heart Disease
- Premature Mortality

Reproductive Effects

- Low Birth Weight
- Infant Mortality
- Premature Birth

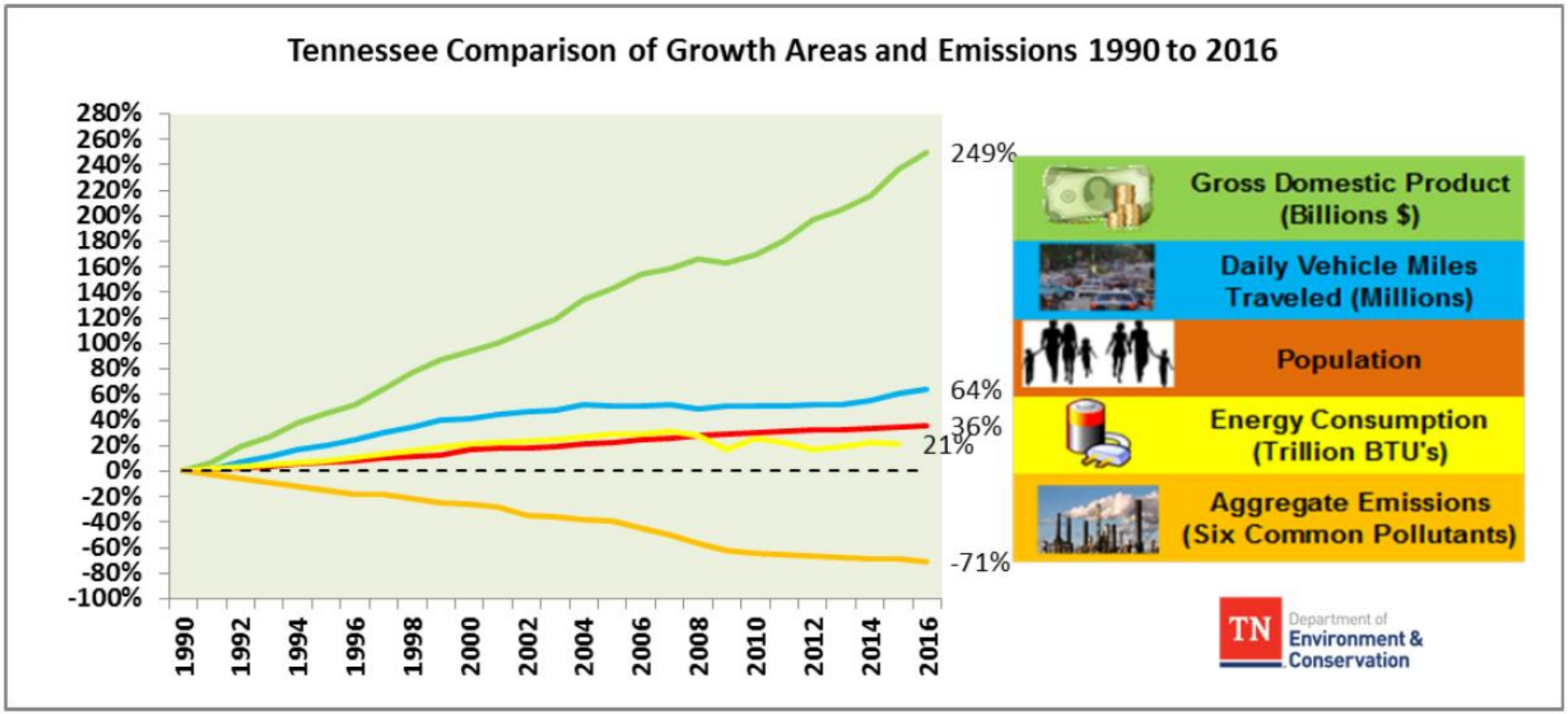
Based on Science in EPA O_3 Integrated Science Assessment (2012)

TN

O_3 Pollution and Asthma

- O_3 exposure is directly linked to asthma (EPA O_3 ISA, 2012).
- 25 million Americans have asthma (CDC, 2018)
- Asthma is the most common chronic condition among children, currently affecting an estimated ***6.2 million children under 18 years***, of which 3.1 million suffered from an asthma attack or episode in 2015. (American Lung Association, 2017)
- Asthma is the top reason for missed school days (Zahran et al. (2018) Vital Signs: Asthma in Children –US, 2001-2016)

Project Motivation: Air Quality Improvements



What AQ and health benefits have resulted from these historic emissions reductions?

Team: An TDEC, DOH, EPA Collaboration

TN DOH

David

Sutapa

TDEC

Me

Mark

Jimmy

Olga

Paul

EPA

- Breanna Alman (OAQPS-RTP)
- Neal Fann (OAQPS-RTP)
- Jason Sacks (ORD-RTP)

Project Scope and Details

- **Scope:**
  - **Quantify air quality and health benefits of TN's historic emission reductions.**
  - **Communicate these benefits to TDEC and regulated community**
- Benefits Model: BenMap
- Area of Interest: 95 TN Counties
- Time Period: 2000 – 2013
- Pollutants: Ozone
- Health Endpoint: Asthma ER Visits

BenMap: A Tool to Estimate Health Benefits

Air Quality

Population

Health Data

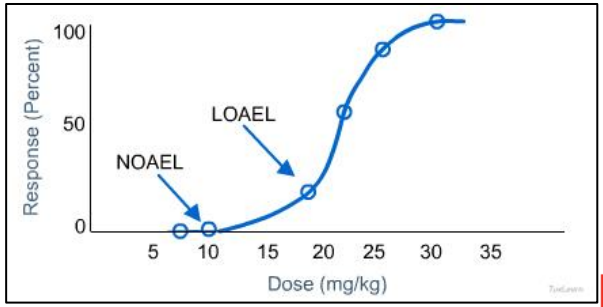
Monitored Data

Population

Health Outcomes

Health-Response Function

Health Impact Attributed to Air Quality



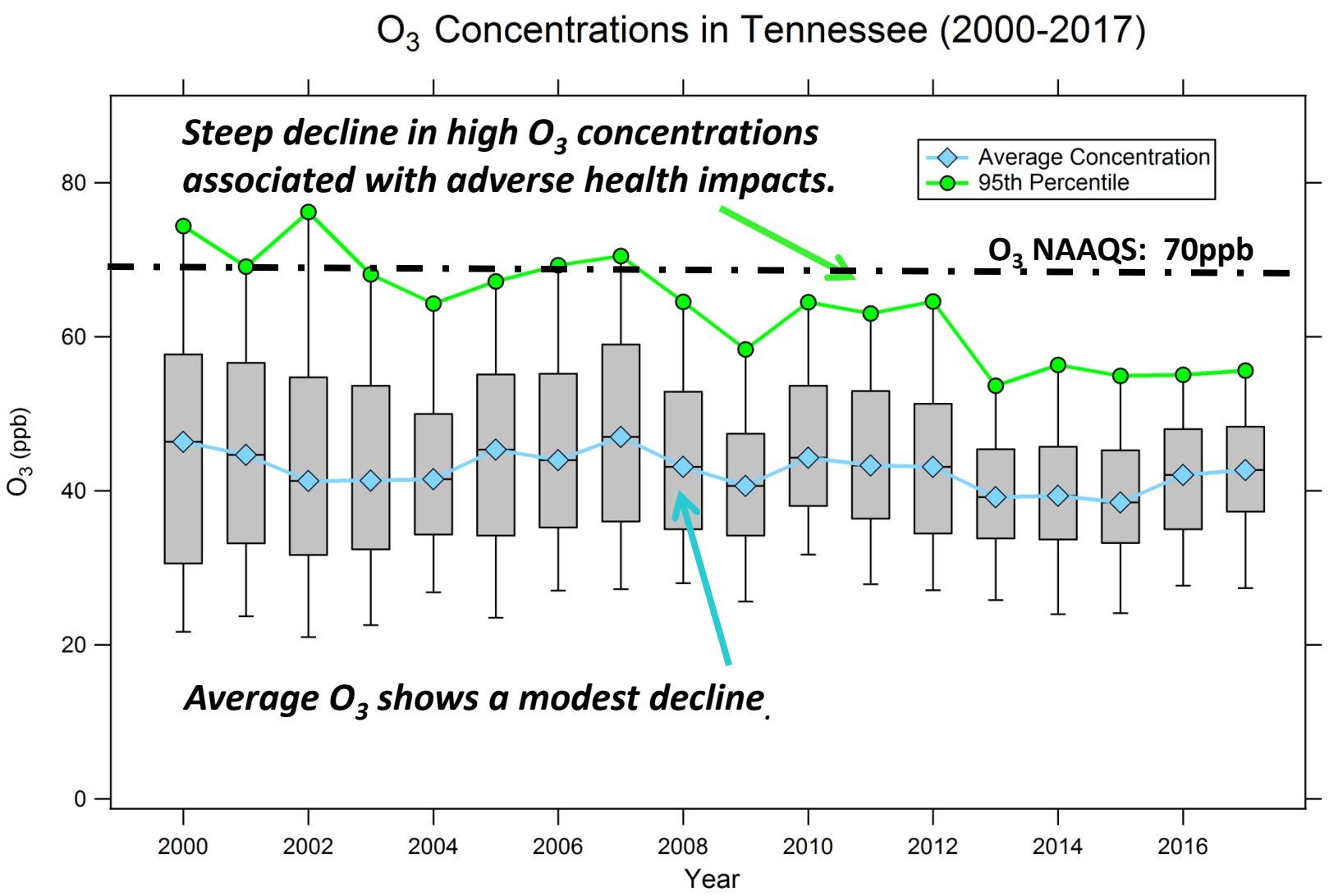
BenMap Input Data

- Air quality data
  - Monitoring (2000-2013), interpolated to county-level O3 concentrations using BenMap
- Health data
  - ER Visits, Asthma provided by TN DOH
- Health function data (dose-response data)
  - ER Visits, Asthma
    - From study conducted in ATL

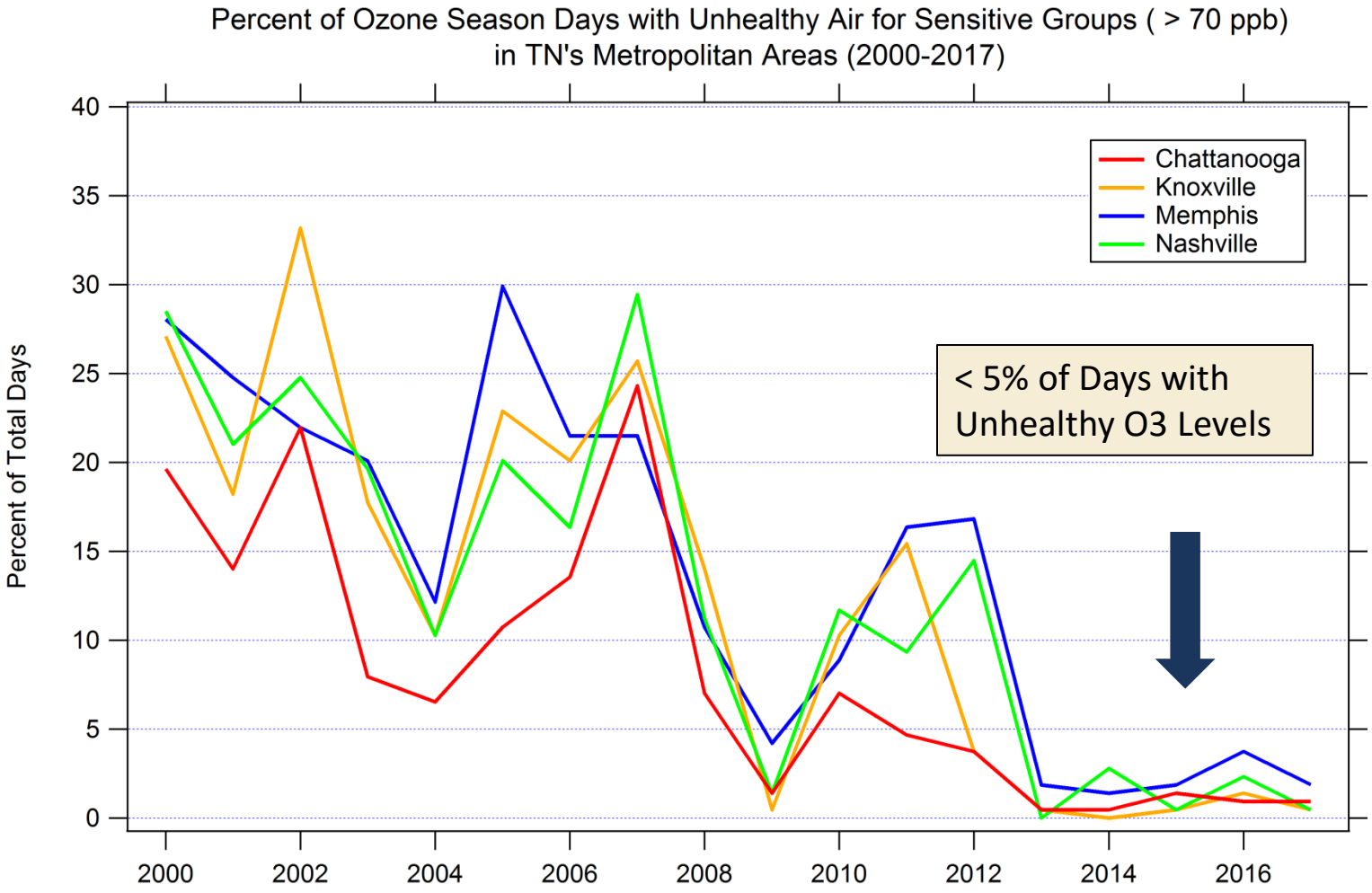
Results

- Air quality monitoring trends
- Emissions trends
- Asthma benefits

O_3 Monitoring Trends in TN (2000 to 2017)



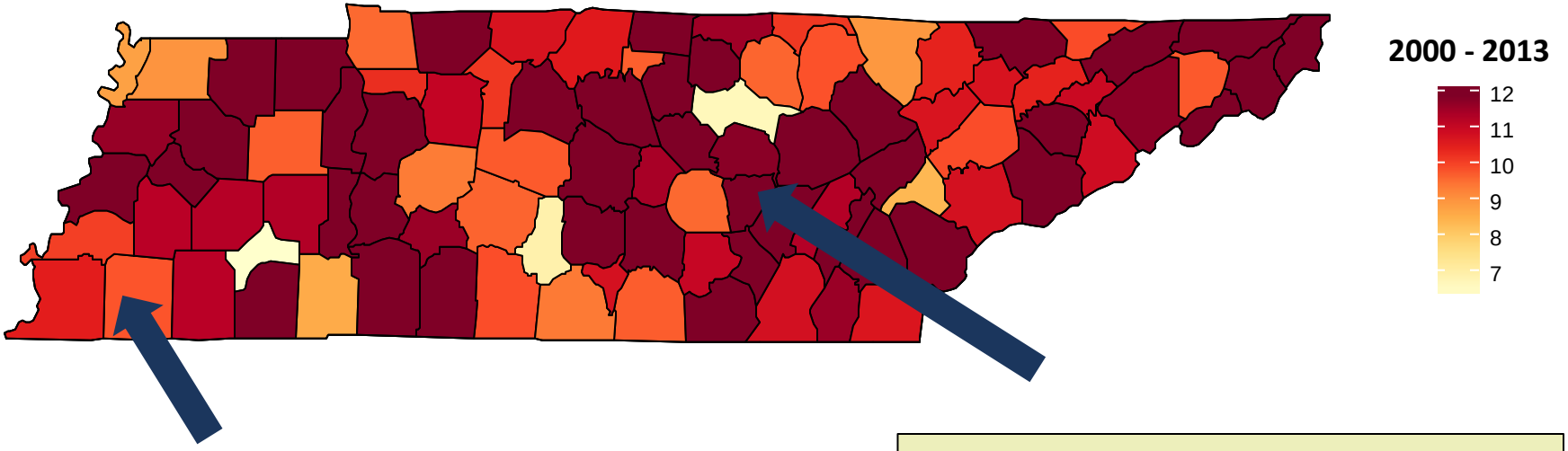
Progress on Reducing "Unhealthy" O_3 Days



Based on Actual 8-hr Monitored Values Reported in Metro Areas, not AQI Forecast!

O_3 Reductions in TN Counties from 2000 to 2013

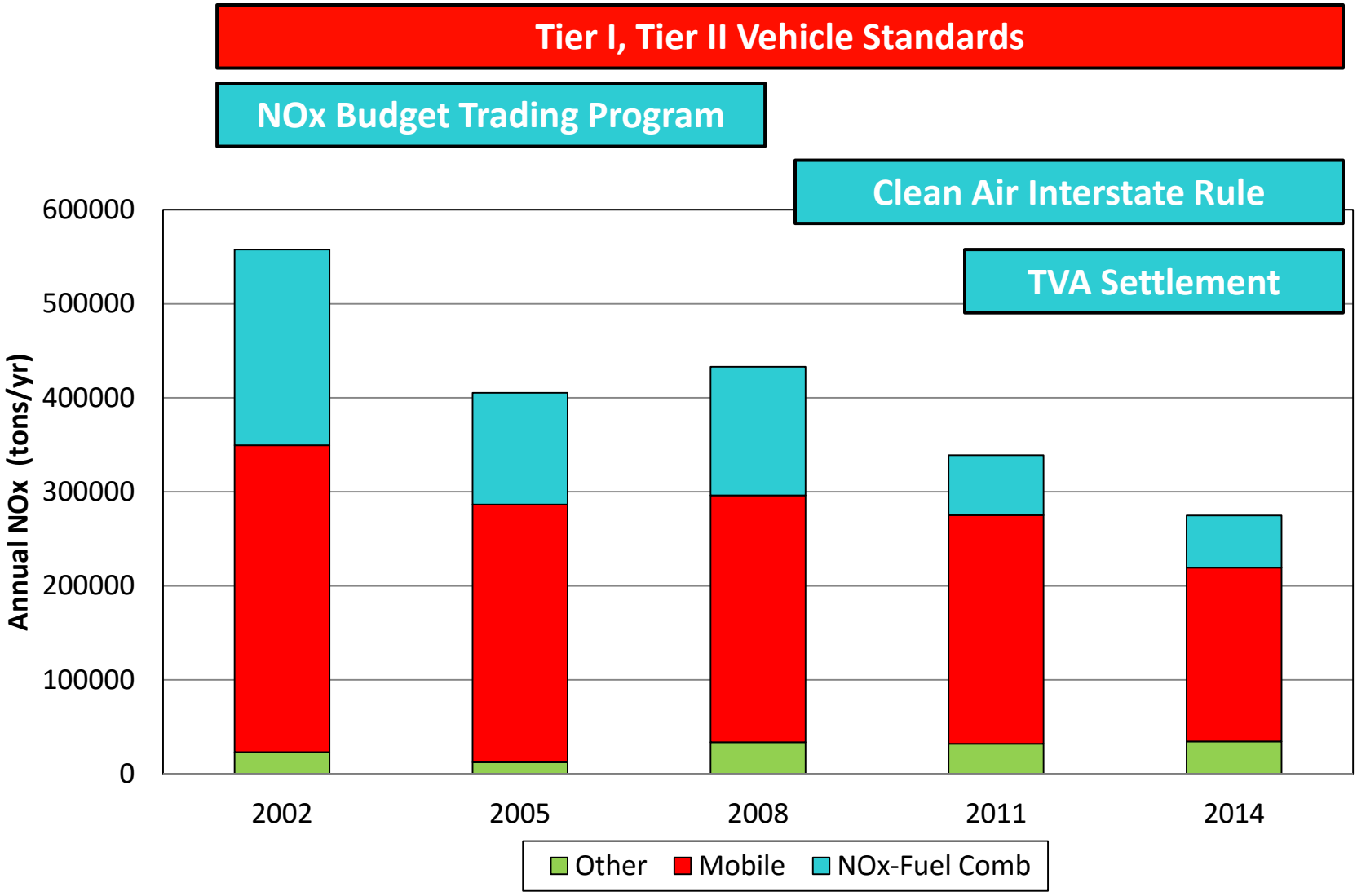
Most TN Counties Observed a 6-12 ppb Reduction in O_3 from 2000 to 2013.



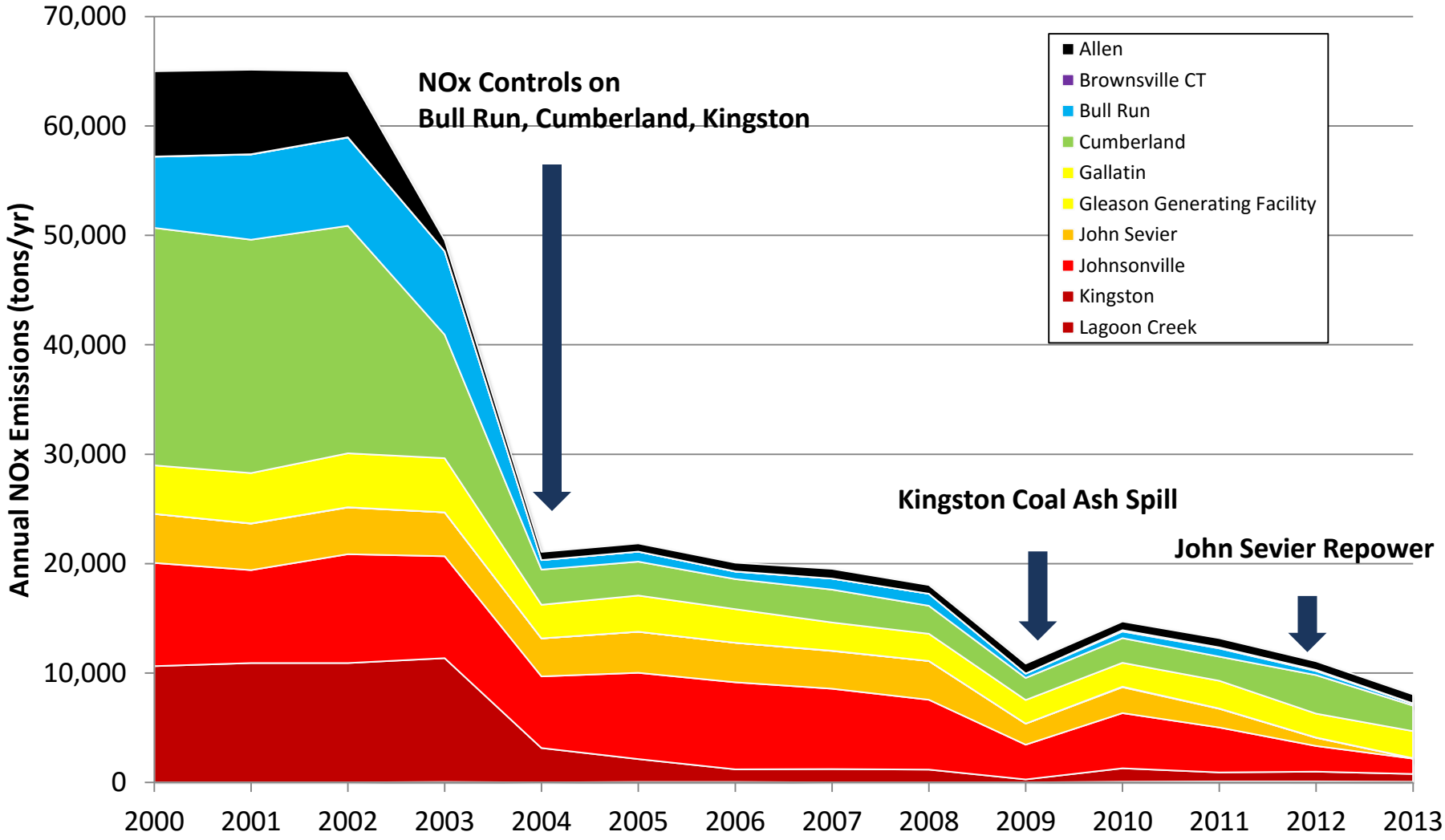
~20% Reduction In/Around Memphis Metro Area

~25% Reduction In/Around Metropolitan Counties (Chattanooga, Knoxville, Nashville)

Dominant Policies Leading to Reductions in O_3-Forming Emissions



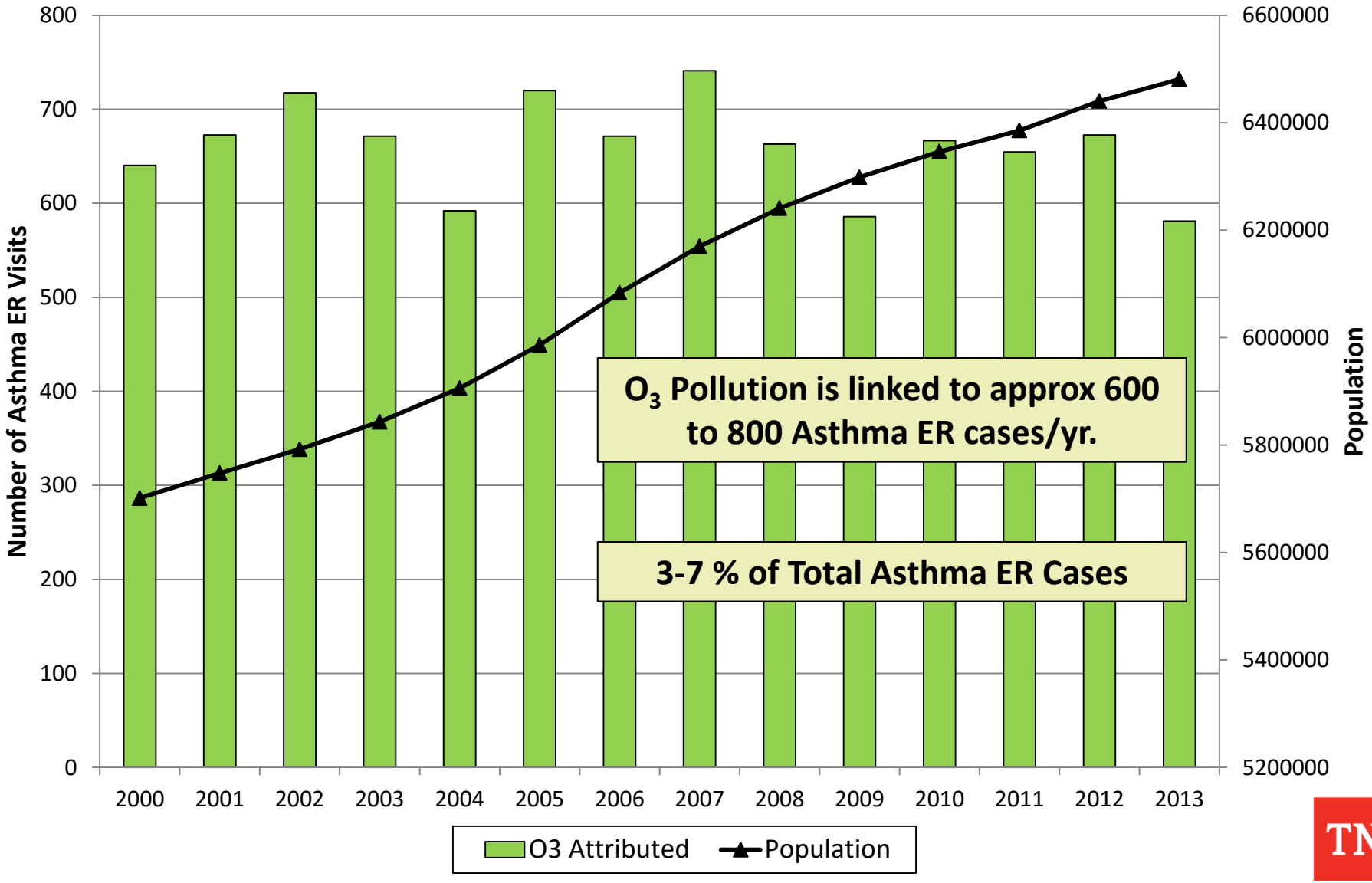
TDEC's Success on Reducing O3-Forming Power Plant Emissions



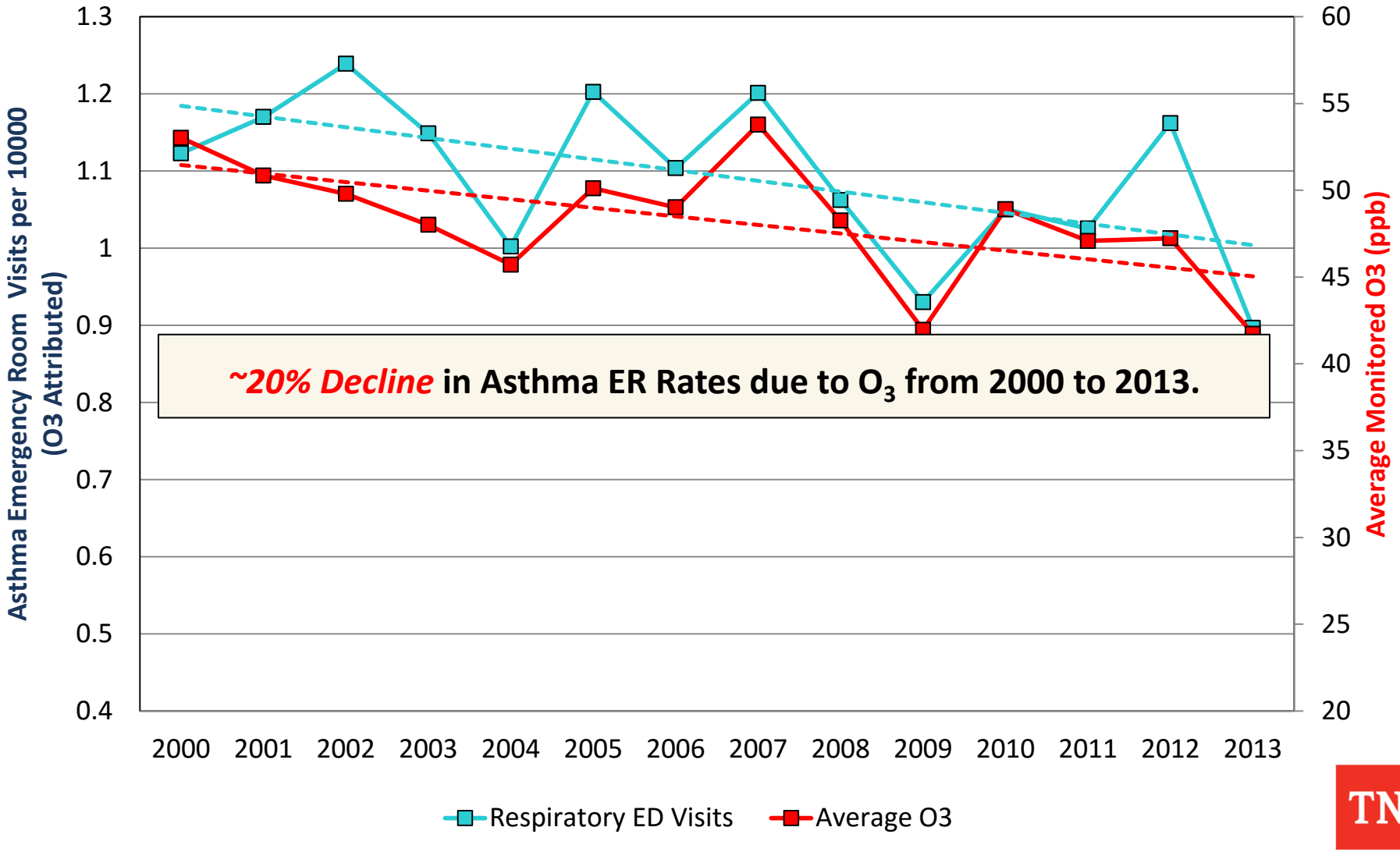
AQ and Emissions Reduction (2000-2013)

- ***Average 20%*** Reduction in TN's outdoor O_3
- ***43% Reduction*** in NOx emissions mobile sources
- ***73% Reduction*** in NOx emissions from fuel combustion (e.g, primarily power plants.
- ***How does this translate to public health in TN?***

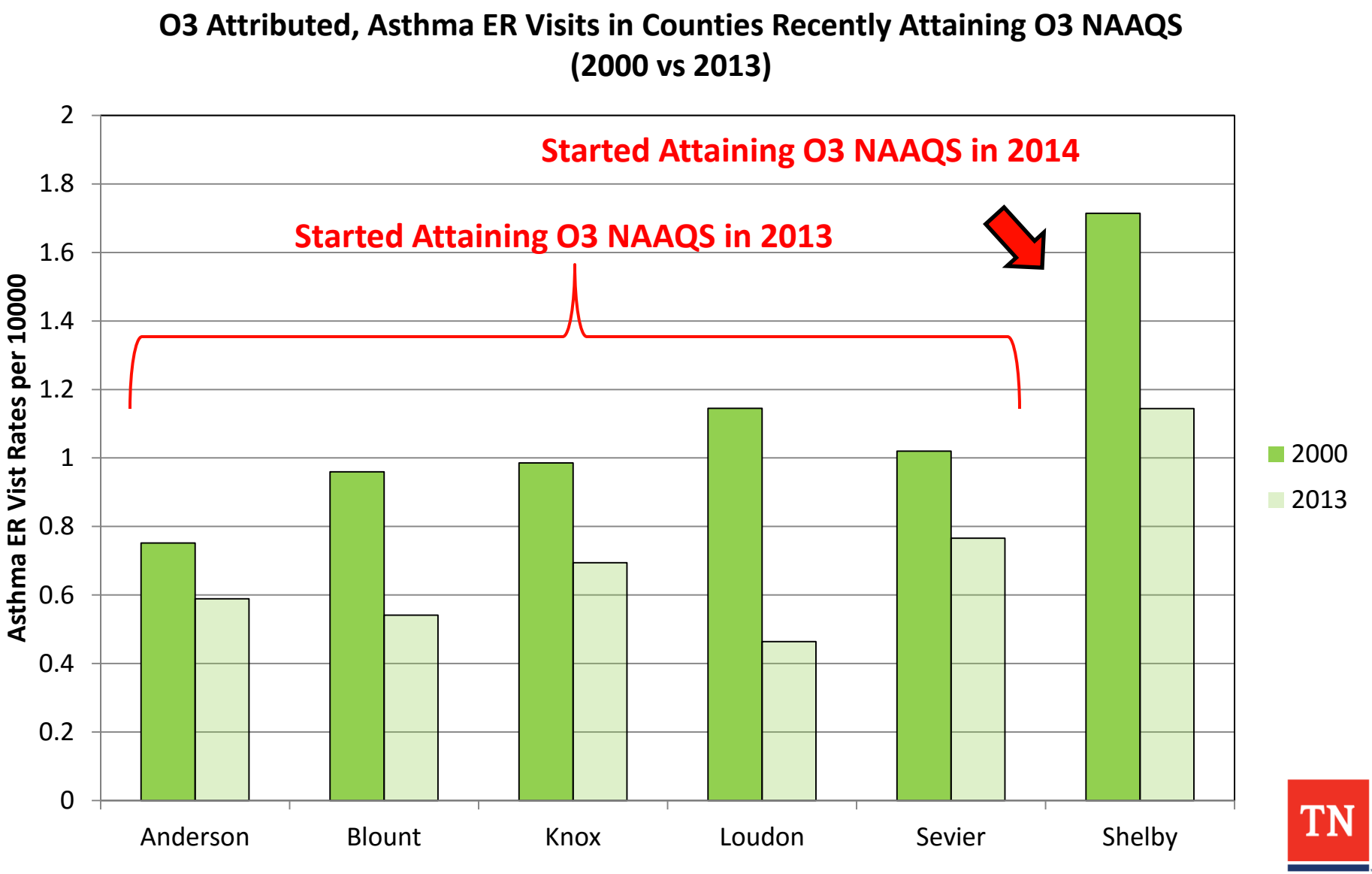
Number of Annual Asthma ER Visits due to O_3



Asthma Emergency Room Visits and O_3 Pollution



Asthma ER Visits in TN Counties (2000 vs 2013)



Summary

- Air quality regulations and state implementation of these regulations are working to protect asthma health in Tennesseans.

- Emissions reductions, primarily from power plants, and to a lesser extent mobile sources, are estimated to have resulted in statewide O_3 reductions of 6-12 ppb.

- From 2000 and 2013, the O_3 attributed, asthma ER rates decreased by an average of 20% in TN.
  - Benefits varied greatly in different metro areas
  - Up to 60% in areas recently attaining O3 NAAQS

Next Steps and Short/Long-term Project Vision

- Effective Communication of Benefits
  - Broad Audience: TDEC Annual Environmental Report, TDEC Website
- Short-term goals:
  - Expand project to other pollutants (PM2.5)
  - Other health outcomes (Childhood Asthma, School Absenteeism)
- Long-term goals
  - Annual update by BenMap team

Questions?

Michelle M. Oakes, Ph.D.
Environmental Manager
Air Quality Assurance Program
Michelle.oakes@tn.gov
615-253-9933